

# BUK7520-55A

## N-channel TrenchMOS standard level FET

Rev. 02 — 15 June 2010

Product data sheet

## 1. Product profile

### 1.1 General description

Standard level N-channel enhancement mode Field-Effect Transistor (FET) in a plastic package using TrenchMOS technology. This product has been designed and qualified to the appropriate AEC standard for use in automotive critical applications.

### 1.2 Features and benefits

- Low conduction losses due to low on-state resistance
- Q101 compliant
- Suitable for standard level gate drive sources
- Suitable for thermally demanding environments due to 175 °C rating

### 1.3 Applications

- 12 V and 24 V loads
- Automotive and general purpose power switching
- Motors, lamps and solenoids

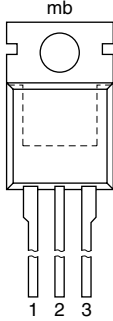
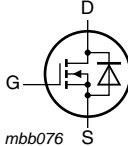
### 1.4 Quick reference data

Table 1. Quick reference data

| Symbol                 | Parameter                                    | Conditions  | Min | Typ | Max | Unit |
|------------------------|--|---|-----|-----|-----|------|
| V <sub>DS</sub>        | drain-source voltage                         | T <sub>j</sub> ≥ 25 °C; T <sub>j</sub> ≤ 175 °C   | -   | -   | 55  | V    |
| I <sub>D</sub>         | drain current                                | V <sub>GS</sub> = 10 V; T <sub>mb</sub> = 25 °C; see <a href="#">Figure 1</a> ; see <a href="#">Figure 3</a>                            | -   | -   | 54  | A    |
| P <sub>tot</sub>       | total power dissipation                      | T <sub>mb</sub> = 25 °C; see <a href="#">Figure 2</a>   | -   | -   | 118 | W    |
| Static characteristics |  |   |     |     |     |      |
| R <sub>DSon</sub>      | drain-source on-state resistance             | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 175 °C; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>   | -   | -   | 40  | mΩ   |
|                        |  | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 25 °C; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>    | -   | 17  | 20  | mΩ   |
| Avalanche ruggedness   |  |   |     |     |     |      |
| E <sub>DS(AL)S</sub>   | non-repetitive drain-source avalanche energy | I <sub>D</sub> = 48 A; V <sub>sup</sub> ≤ 55 V; R <sub>GS</sub> = 50 Ω; V <sub>GS</sub> = 10 V; T <sub>j(init)</sub> = 25 °C; unclamped | -   | -   | 115 | mJ   |

## 2. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description                       | Simplified outline  | Graphic symbol  |
|-----|--------|-----------------------------------|---|---|
| 1   | G      | gate                              |  |  |
| 2   | D      | drain                             |   |   |
| 3   | S      | source                            |   |   |
| mb  | D      | mounting base; connected to drain |   |   |

**SOT78 (TO-220AB)**

## 3. Ordering information

Table 3. Ordering information

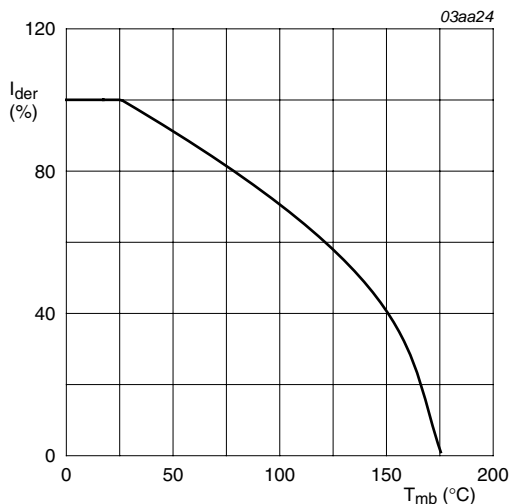
| Type number | Package  |  |         |
|-------------|----------|--|---------|
|             | Name     | Description  | Version |
| BUK7520-55A | TO-220AB | plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB | SOT78   |

## 4. Limiting values

**Table 4. Limiting values**

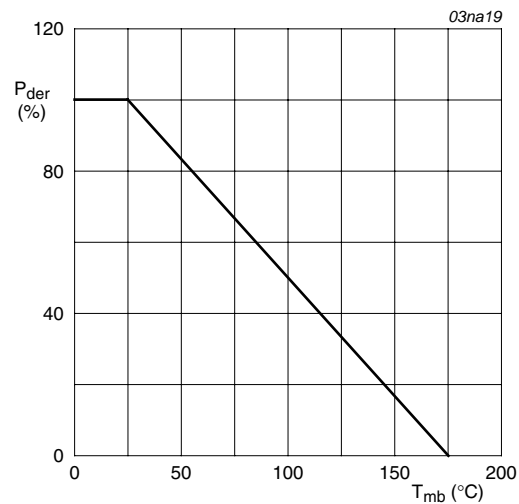
In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol                      | Parameter  | Conditions   | Min | Typ | Max | Unit               |
|-----------------------------|--|--|-----|-----|-----|--------------------|
| $V_{DS}$                    | drain-source voltage                               | $T_j \geq 25\text{ }^{\circ}\text{C}$ ; $T_j \leq 175\text{ }^{\circ}\text{C}$   | -   | -   | 55  | V                  |
| $V_{DGR}$                   | drain-gate voltage                                 | $R_{GS} = 20\text{ k}\Omega$   | -   | -   | 55  | V                  |
| $V_{GS}$                    | gate-source voltage                                |  | -20 | -   | 20  | V                  |
| $I_D$                       | drain current                                      | $T_{mb} = 25\text{ }^{\circ}\text{C}$ ; $V_{GS} = 10\text{ V}$ ; see <a href="#">Figure 1</a> ;<br>see <a href="#">Figure 3</a>  | -   | -   | 54  | A                  |
|                             |  | $T_{mb} = 100\text{ }^{\circ}\text{C}$ ; $V_{GS} = 10\text{ V}$ ; see <a href="#">Figure 1</a>   | -   | -   | 38  | A                  |
| $I_{DM}$                    | peak drain current                                 | $T_{mb} = 25\text{ }^{\circ}\text{C}$ ; $t_p \leq 10\text{ }\mu\text{s}$ ; pulsed;<br>see <a href="#">Figure 3</a>   | -   | -   | 217 | A                  |
| $P_{tot}$                   | total power dissipation                            | $T_{mb} = 25\text{ }^{\circ}\text{C}$ ; see <a href="#">Figure 2</a>   | -   | -   | 118 | W                  |
| $T_{stg}$                   | storage temperature                                |  | -55 | -   | 175 | $^{\circ}\text{C}$ |
| $T_j$                       | junction temperature                               |  | -55 | -   | 175 | $^{\circ}\text{C}$ |
| <b>Source-drain diode</b>   |  |  |     |     |     |                    |
| $I_S$                       | source current                                     | $T_{mb} = 25\text{ }^{\circ}\text{C}$  | -   | -   | 54  | A                  |
| $I_{SM}$                    | peak source current                                | $t_p \leq 10\text{ }\mu\text{s}$ ; pulsed; $T_{mb} = 25\text{ }^{\circ}\text{C}$   | -   | -   | 217 | A                  |
| <b>Avalanche ruggedness</b> |  |  |     |     |     |                    |
| $E_{DS(AL)S}$               | non-repetitive<br>drain-source<br>avalanche energy | $I_D = 48\text{ A}$ ; $V_{sup} \leq 55\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ;<br>$V_{GS} = 10\text{ V}$ ; $T_{j(\text{init})} = 25\text{ }^{\circ}\text{C}$ ; unclamped | -   | -   | 115 | mJ                 |



$$I_{der} = \frac{I_D}{I_{D(25^{\circ}\text{C})}} \times 100\%$$

**Fig 1. Normalized continuous drain current as a function of mounting base temperature**



$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}\text{C})}} \times 100\%$$

**Fig 2. Normalized total power dissipation as a function of mounting base temperature**

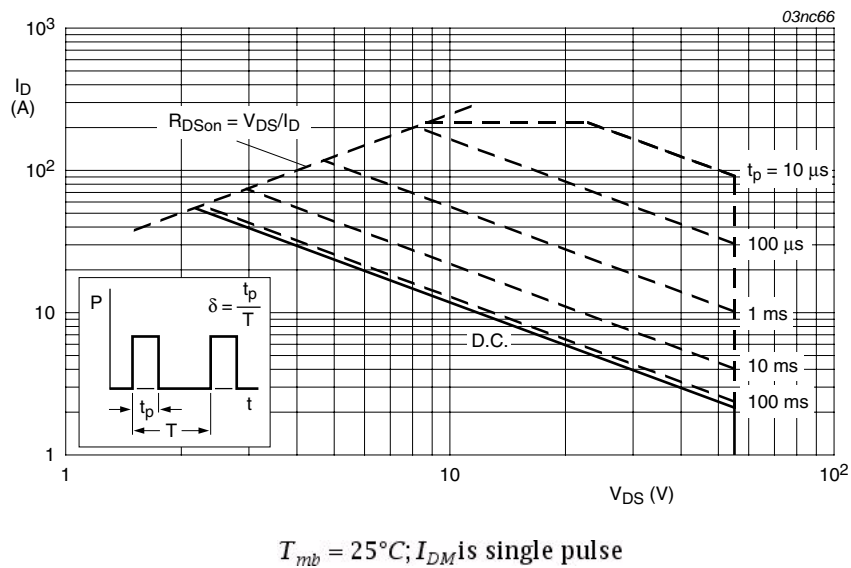


Fig 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

## 5. Thermal characteristics

Table 5. Thermal characteristics

| Symbol         | Parameter   | Conditions                   | Min | Typ | Max | Unit |
|----------------|---|------------------------------|-----|-----|-----|------|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | see <a href="#">Figure 4</a> | -   | -   | 1.2 | K/W  |
| $R_{th(j-a)}$  | thermal resistance from junction to ambient       | vertical in still air        | -   | 60  | -   | K/W  |

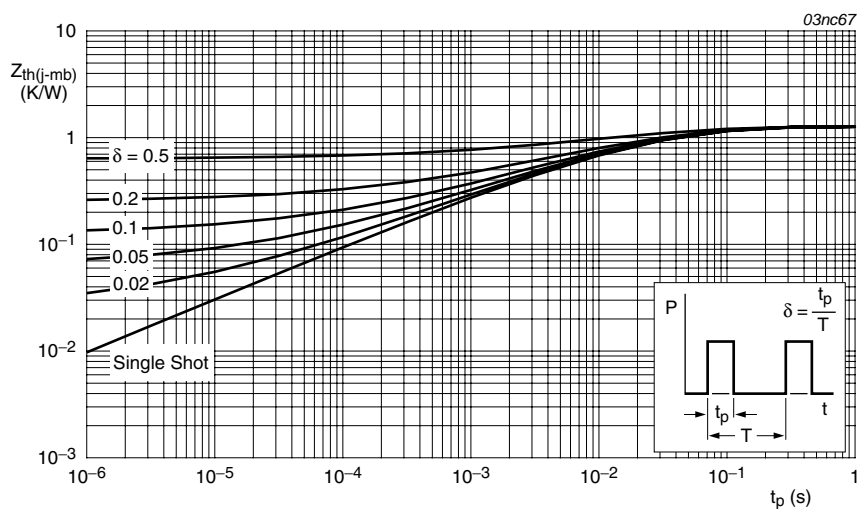
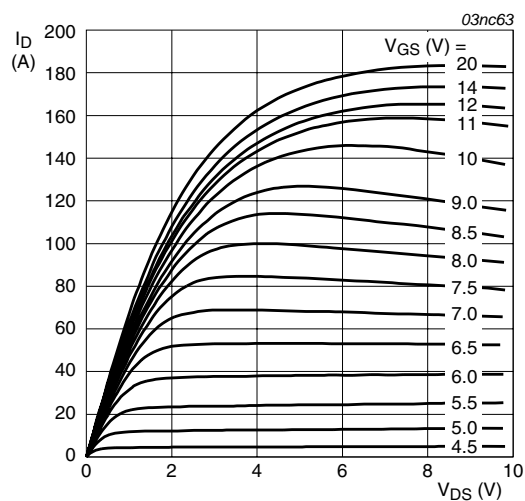


Fig 4. Transient thermal impedance from junction to solder point as a function of pulse duration

## 6. Characteristics

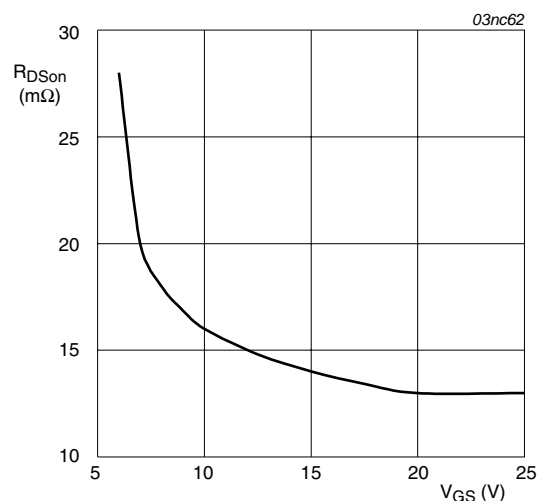
Table 6. Characteristics

| Symbol                  | Parameter                        | Conditions  | Min | Typ  | Max  | Unit |
|-------------------------|----------------------------------|---|-----|------|------|------|
| Static characteristics  |                                  |   |     |      |      |      |
| V <sub>(BR)DSS</sub>    | drain-source breakdown voltage   | I <sub>D</sub> = 0.25 mA; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C   | 55  | -    | -    | V    |
|                         |                                  | I <sub>D</sub> = 0.25 mA; V <sub>GS</sub> = 0 V; T <sub>j</sub> = -55 °C  | 50  | -    | -    | V    |
| V <sub>GS(th)</sub>     | gate-source threshold voltage    | I <sub>D</sub> = 1 mA; V <sub>DS</sub> = V <sub>GS</sub> ; T <sub>j</sub> = 175 °C; see <a href="#">Figure 11</a>                     | 1   | -    | -    | V    |
|                         |                                  | I <sub>D</sub> = 1 mA; V <sub>DS</sub> = V <sub>GS</sub> ; T <sub>j</sub> = 25 °C; see <a href="#">Figure 11</a>                      | 2   | 3    | 4    | V    |
|                         |                                  | I <sub>D</sub> = 1 mA; V <sub>DS</sub> = V <sub>GS</sub> ; T <sub>j</sub> = -55 °C; see <a href="#">Figure 11</a>                     | -   | -    | 4.4  | V    |
| I <sub>DSS</sub>        | drain leakage current            | V <sub>DS</sub> = 55 V; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 175 °C  | -   | -    | 500  | µA   |
|                         |                                  | V <sub>DS</sub> = 55 V; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C   | -   | 0.05 | 10   | µA   |
| I <sub>GSS</sub>        | gate leakage current             | V <sub>DS</sub> = 0 V; V <sub>GS</sub> = 20 V; T <sub>j</sub> = 25 °C   | -   | 2    | 100  | nA   |
|                         |                                  | V <sub>DS</sub> = 0 V; V <sub>GS</sub> = -20 V; T <sub>j</sub> = 25 °C  | -   | 2    | 100  | nA   |
| R <sub>DSon</sub>       | drain-source on-state resistance | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 175 °C; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a> | -   | -    | 40   | mΩ   |
|                         |                                  | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 25 °C; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>  | -   | 17   | 20   | mΩ   |
| Dynamic characteristics |                                  |   |     |      |      |      |
| C <sub>iss</sub>        | input capacitance                | V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 25 V; f = 1 MHz; T <sub>j</sub> = 25 °C; see <a href="#">Figure 14</a>                       | -   | 1200 | 1592 | pF   |
| C <sub>oss</sub>        | output capacitance               |   | -   | 290  | 356  | pF   |
| C <sub>rss</sub>        | reverse transfer capacitance     |   | -   | 179  | 240  | pF   |
| t <sub>d(on)</sub>      | turn-on delay time               | V <sub>DS</sub> = 30 V; R <sub>L</sub> = 1.2 Ω; V <sub>GS</sub> = 10 V; R <sub>G(ext)</sub> = 10 Ω; T <sub>j</sub> = 25 °C            | -   | 15   | -    | ns   |
| t <sub>r</sub>          | rise time                        |   | -   | 74   | -    | ns   |
| t <sub>d(off)</sub>     | turn-off delay time              |   | -   | 70   | -    | ns   |
| t <sub>f</sub>          | fall time                        |   | -   | 40   | -    | ns   |
| L <sub>D</sub>          | internal drain inductance        | from drain lead 6 mm from package to centre of die ; T <sub>j</sub> = 25 °C   | -   | 4.5  | -    | nH   |
|                         |                                  | from contact screw on mounting base to centre of die ; T <sub>j</sub> = 25 °C   | -   | 3.5  | -    | nH   |
| L <sub>S</sub>          | internal source inductance       | from source lead to source bond pad ; T <sub>j</sub> = 25 °C  | -   | 7.5  | -    | nH   |
| Source-drain diode      |                                  |   |     |      |      |      |
| V <sub>SD</sub>         | source-drain voltage             | I <sub>S</sub> = 20 A; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C; see <a href="#">Figure 15</a>                                   | -   | 0.85 | 1.2  | V    |
| t <sub>rr</sub>         | reverse recovery time            | I <sub>S</sub> = 20 A; dI <sub>S</sub> /dt = -100 A/µs; V <sub>GS</sub> = -10 V; V <sub>DS</sub> = 30 V; T <sub>j</sub> = 25 °C       | -   | 45   | -    | ns   |
| Q <sub>r</sub>          | recovered charge                 |   | -   | 110  | -    | nC   |



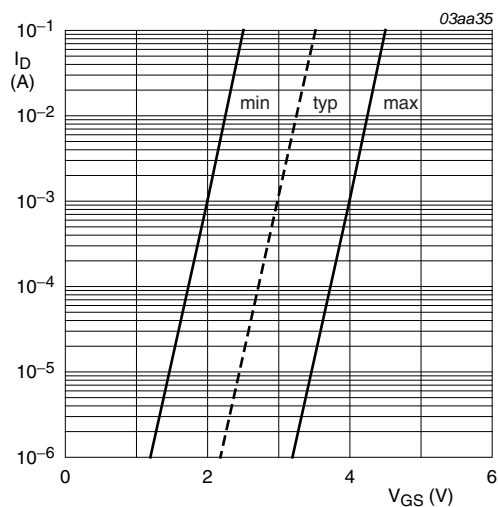
$$T_j = 25^\circ\text{C}; t_p = 300\mu\text{s}$$

Fig 5. Output characteristics: drain current as a function of drain-source voltage; typical values



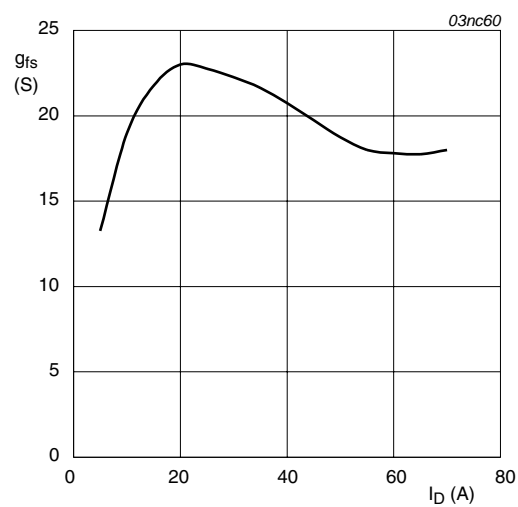
$$T_j = 25^\circ\text{C}; I_D = 25\text{A}$$

Fig 6. Drain-source on-state resistance as a function of drain current; typical values



$$T_j = 25^\circ\text{C}; V_{DS} = 5\text{V}$$

Fig 7. Sub-threshold drain current as a function of gate-source voltage



$$T_j = 25^\circ\text{C}; V_{DS} = 25\text{V}$$

Fig 8. Forward transconductance as a function of drain current; typical values

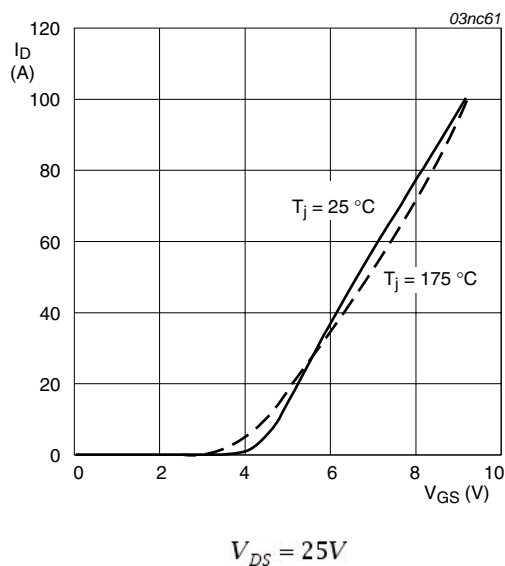


Fig 9. Transfer characteristics: drain current as a function of gate-source voltage; typical values

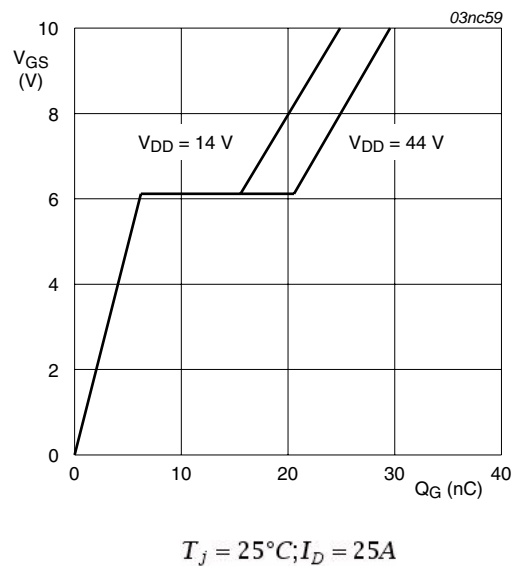


Fig 10. Gate-source voltage as a function of turn-on gate charge; typical values

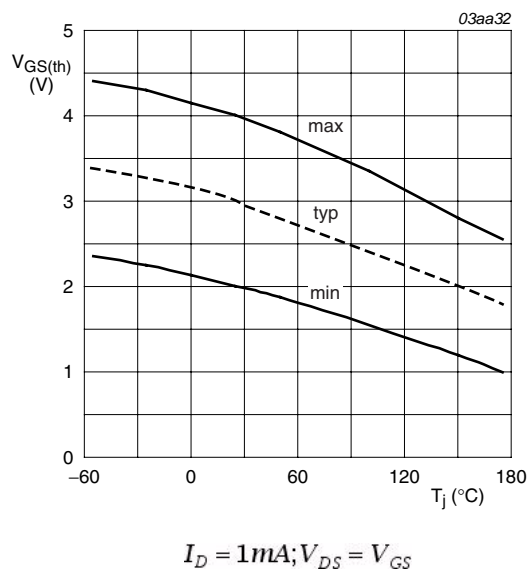


Fig 11. Gate-source threshold voltage as a function of junction temperature

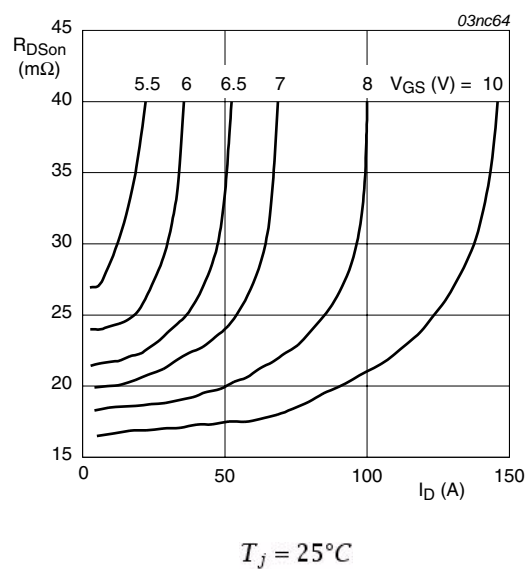
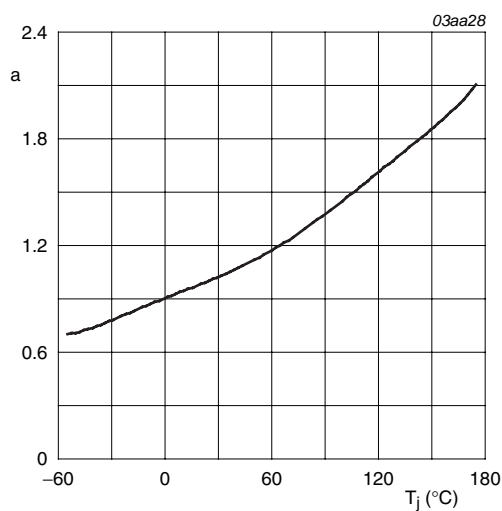


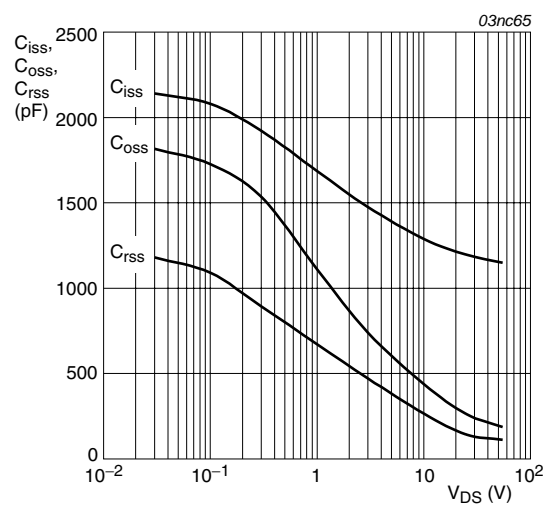
Fig 12. Drain-source on-state resistance as a function of drain current; typical values





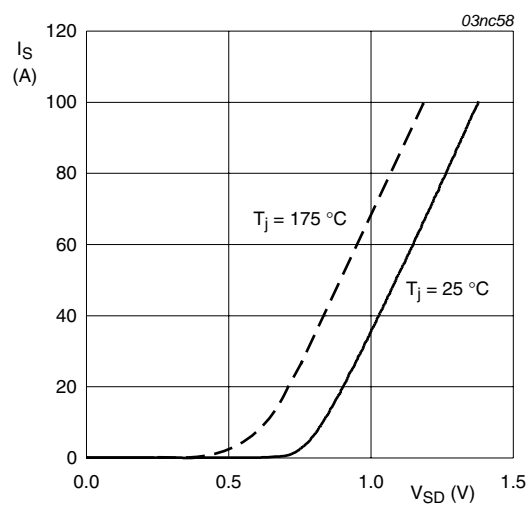
$$a = \frac{R_{DSon}}{R_{DSon(25^{\circ}\text{C})}}$$

Fig 13. Normalized drain-source on-state resistance factor as a function of junction temperature



$$V_{GS} = 0\text{V}; f = 1\text{MHz}$$

Fig 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



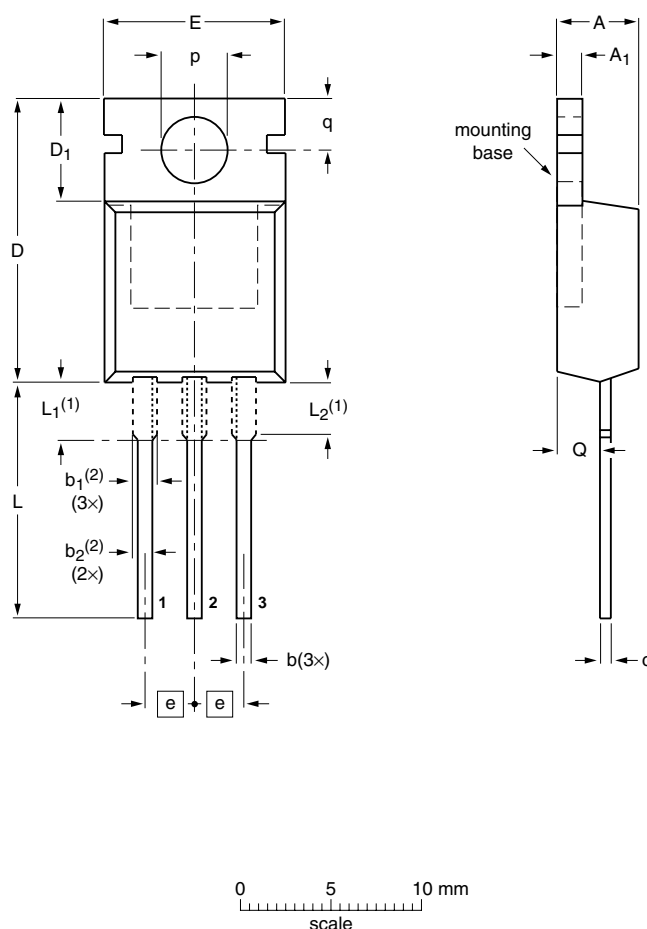
$$V_{GS} = 0\text{V}$$

Fig 15. Reverse diode current as a function of reverse diode voltage; typical values

## 7. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB

SOT78



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | A <sub>1</sub> | b          | b <sub>1</sub> (2) | b <sub>2</sub> (2) | c          | D            | D <sub>1</sub> | E           | e    | L            | L <sub>1</sub> (1) | L <sub>2</sub> (1)<br>max. | p          | q          | Q          |
|------|------------|----------------|------------|--------------------|--------------------|------------|--------------|----------------|-------------|------|--------------|--------------------|----------------------------|------------|------------|------------|
| mm   | 4.7<br>4.1 | 1.40<br>1.25   | 0.9<br>0.6 | 1.6<br>1.0         | 1.3<br>1.0         | 0.7<br>0.4 | 16.0<br>15.2 | 6.6<br>5.9     | 10.3<br>9.7 | 2.54 | 15.0<br>12.8 | 3.30<br>2.79       | 3.0                        | 3.8<br>3.5 | 3.0<br>2.7 | 2.6<br>2.2 |

### Notes

- Lead shoulder designs may vary.
- Dimension includes excess dambar.


| OUTLINE<br>VERSION | REFERENCES |                 |       |  | EUROPEAN<br>PROJECTION  | ISSUE DATE           |
|--------------------|------------|-----------------|-------|--|---|----------------------|
|                    | IEC        | JEDEC           | JEITA |  |   |                      |
| SOT78              |            | 3-lead TO-220AB | SC-46 |  |  | 08-04-23<br>08-06-13 |

Fig 16. Package outline SOT78 (TO-220AB)

## 8. Revision history

**Table 7.** Revision history

| Document ID          | Release date   | Data sheet status     | Change notice | Supersedes           |
|----------------------|--|-----------------------|---------------|----------------------|
| BUK7520-55A v.2      | 20100615   | Product data sheet    | -             | BUK7520_7620_55A v.1 |
| Modifications:       | <ul style="list-style-type: none"><li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li><li>• Legal texts have been adapted to the new company name where appropriate.</li><li>• Type number BUK7520-55A separated from data sheet BUK7520_7620_55A v.1.</li></ul> |                       |               |                      |
| BUK7520_7620_55A v.1 | 20010118   | Product specification | -             | -                    |

## 9. Legal information

### 9.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | Definition  |
|-----------------------------------|-------------------------------|---|
| Objective [short] data sheet      | Development                   | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet    | Qualification                 | This document contains data from the preliminary specification.                       |
| Product [short] data sheet        | Production                    | This document contains the product specification.                                     |

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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## 11. Contents

|           |                                |           |
|-----------|--------------------------------|-----------|
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